First observation of the atomistic source of mechanical toughness in glass bio-cements during setting

An invited talk

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Bio-cements, notably glass-ionomer cements, have been in widespread use for over 40 years in dentistry and medicine. Progress in improving their mechanical properties, however, lags behind the toughness needed for permanent implants. A significant impediment to improvement has been the need to use conventional mechanical failure methods, which are necessarily retrospective. Through the novel use of neutron Compton scattering, and also terahertz spectroscopy and DSC (Nature Communications 6 8631pp 1-10 (2015)), it has been possible to relate fracture toughness during setting to atomic cohesion, from which fluctuations in interfacial configurations during chelation between the highly phase separated glass and the PAA polymer are observed. In this paper we show how, compared to convention, the setting of glass-ionomer cements is not monotonic. Rather, as they set, abrupt features are found in the development of mechanical toughness, which have not been previously detected. These provide clues by which mechanical performance of bio-cements might be improved.